U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TECHNICAL NOTE

Filing Code 7385
Date Issued 1-15-70

Bureau of Land Management U.S. DEPARTMENT OF THE INTERIOR

OBSERVATIONS OF OVERLAND FLOW ON A TREATED AND UNTREATED JUNIPER AREA

by

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Many workers interested in juniper chaining as a method to prevent overland flow have questioned its effectiveness. The author made limited measurements under a known minimum storm intensity in both a treated and untreated juniper area. The rain fell and was measured the afternoon of July 19, 1969, and the soil and ground cover data was made the morning of July 20, 1969. The data was gathered from the Pine Canyon Watershed, Las Vegas District, Nevada. The plots are within one of twelve research watersheds where basic information is being collected by the University of Nevada and the BLM.

The plots were paired as to slope, exposure, vegetative type, and soil depth. Precipitation was measured at three raincans and the duration was checked at a precipitation recorder. The raincan and recorder were within one-half mile of the plots. The author was present during the storm and through visual observations it was determined that the rainfall and intensity was approximately the same on the plots as occurred at the raincan and recorder.

Conditions. The plots are located on a north exposure with an average slope of 13 percent. Soils are typical of the fine, mixed, mesic family of Mollic Durargids. These soils belong to the D hydrologic group and have a profile available water holding capacity of 4.5 inches. 1/ The soil texture was silt loam from 0-4" and clay loam 4"-18". Effective root depth is 18". The elevation is about 5700 feet. Precipitation for the area is estimated at 12". The precipitation at Pioche, Nevada is the most applicable to the plot area, both in amounts and when moisture is received.

1/ Vegetation and Soil of the Pine and Mathew Canyon Watershed. University of Nevada and Bureau of Land Management, April 1969.

TABLE I
Percent Cover

Species	NOT TREATED Canopy	NOT TREATED Basal	TREATED 2/ Canopy	TREATED 2/ Basal
Sandberg bluegrass		3		
Squirreltail		2	2	4
Thurber needlegrass				1
Blue gramma				1
Muttongrass				2
Desert wheatgrass				1
Aster	1			
Eriogonum		1		3
Tailcup lupine			1	1
Utah Juniper	8		4	
Big sagebrush	7		11	
Cliffrose	1			
Singleleaf pinyon	1			
Douglas rabbitbrush		1	1	
Litter	18			27
Pavement (1/8"-2")	26			19
Rock (2"+)	18			13
Bare Ground	13			9
Total	93	7	19	81

2/ Chained 1957 one-way.

The ground was dry and hard, about normal for July in southeastern Nevada. The rainstorm lasted for fifteen minutes and measured 0.85 inches. Moisture penetration immediately following the storm was 3.75" in the open erosion pavement area (Fig. 9) and 5.0" adjacent to a desert wheatgrass plant (Fig. 5), both in the treated area. In the untreated area the moisture penetrated 3.0" in the open erosion pavement area and 9.0" under the juniper duff. The next day following the storm the moisture had drained by gravity to a depth of 18" to 20" with the top 1 to 3 inches of the soil profile almost dry.

Ground Cover. Table I gives an indication of the ground cover on the two plots and figures 1 through 10 give a visual observation of the treated plot and figures 11 through 13 of the non-treated plots.

The treated type has resulted from chaining and seeding of the juniper (*Juniperus osteosperma*), big sagebrush (*Artemisia tridentata*), squirrel-tail (*Sitanion hystrix*), and juniper, big sagebrush, Sandberg bluegrass

(Poa secunda) communities. Juniper occurs with 73.2 trees per acre and 2.8 percent cover, big sagebrush with 4.2 percent cover and desert wheatgrass with 5.0 percent.

The nontreated type contains on the average 147 juniper and 13 pinyon trees per acre with 19.9 and 0.9 percent cover respectively, and big sagebrush 7.2 percent cover.

The pace transects in each plot varied from the average type coverage showing that the plots were not representative of the type.

Other observations not applicable to the plots were also made:

1. Water barely started to run off a compacted, well graded dirt road when the precipitation exceeded 0.10" in 10 minutes.

2. Water was collecting in the borrow areas and runoff was very noticeable when 0.20" in 15 minutes was reached.

3. Runoff was collecting from the roads in the natural drainages and peakflows were starting when rainfall reached 0.35" in 15 minutes.

4. Runoff had not occurred from the vegetative areas, big sagebrush, nontreated and treated juniper areas and on slopes up to 24 percent until the rainfall rate and intensity reached .75 in 15 minutes.

5. Runoff from both treated and nontreated areas occurred when the rainfall exceeded 0.80" in 15 minutes.

6. Debris was deposited in the drainage ditches adjacent to the roads on the nontreated juniper area but not on the chained-one way treated juniper area.

7. Moisture penetration

		Depth		
Time	Rate	Erosion Pavement	Vegetation	Slope
15 min.	.2	1/2"	1-1/8"	4%
"	.3	1"	1-1/2"	3%
"	.65	2-1/2"	4"	5%
"	.8	3-3/4"	5"	6%
"	.8+	3"	9" 3/	15%

3/ Juniper duff--could have collected runoff also.

Figure 1.

Figure 1. Area on right chained one way 1957; area on left original juniper, sagebrush cover.

A. Pinyon Juniper chained 1957--Once over

The drainage reach started thirty feet behind Jim Brunner (Fig. 2).

Figure 2.

Sheet erosion and overland flow were not identifiable in the first twenty-one feet of the drainage the day after an .8" storm.

Figure 3.

From 21' to 66' (Juniper obstruction) (Fig. 2), the overland flow sheet and rill erosion was clearly identifiable. (Fig. 3 and 4).

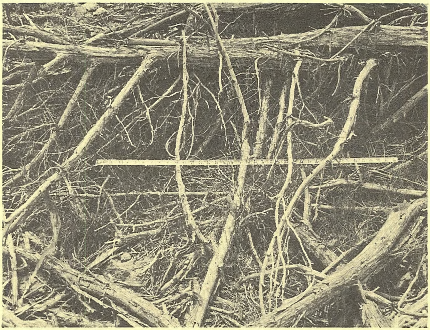
Figure 4.

Sediment was deposited against the grass-litter check dam (Fig. 5) for a distance of three feet (Fig. 6). The chained juniper had for the past twelve years provided a micro environment that allowed accumulation of soil, establishment of introduced and native grasses and shrubs in addition to providing an effective check dam and infiltration field that prevented loss of soil on site and stopped overland flow 100%. (Fig. 7).

Figure 5.

Figure 6.

Figure 7.



B. Pinyon Juniper chained 1957--Once over

The drainage reach started 175' behind Jim Brunner (Fig. 8).

Figure 8.

Overland flow and sheet erosion was barely identifiable for the first 115 feet. The next 60 feet sustained slight sheet erosion followed by an additional 50 feet of moderate to severe sheet erosion.

Figure 9.

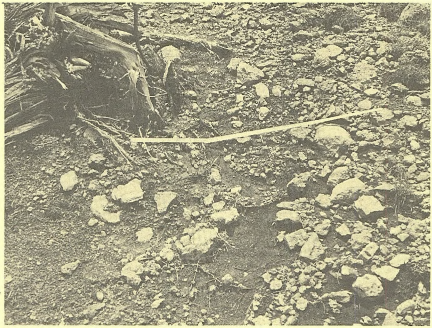


Figure 10.

At 225 feet a juniper litter obstruction diverted the water at a 25° angle, but was unable to reduce the velocity sufficiently to prevent the water and sediments from penetrating the debris and continuing its erosive action. Rill erosion was evident immediately downstream from the obstruction which included juniper litter, crested wheat and squirreltail grasses. (Fig. 10). The water and sediment continued another 300 feet until the sediment was deposited in a recently cleaned access road ditch and the water continued down the ditch and crossed the road and into the main drainage channel.

C. Pinyon-Juniper--Not chained

The drainage reach started 165' behind Jim Brunner (Fig. 11).

Figure 11.

Velocity and volume of the overland flow was sufficient to cut through two to four inches deep of juniper duff that had been in place many years (estimate 6 years). The water flow was diverted by the juniper duff, the smallest volume going along the left side of Fig. 11 causing very little erosion. The majority of the volume was directed along the right side of Fig. 11 causing rill and gully erosion. (Fig. 12 and 13).

Figure 12.

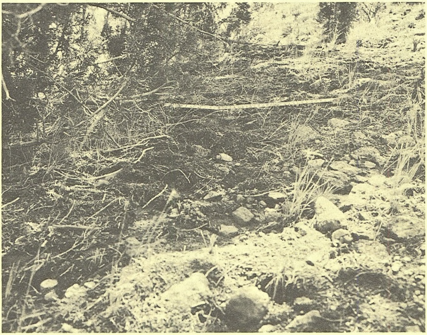
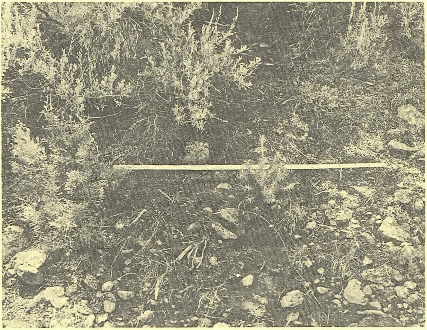


Figure 13.



The litter, sediment and water continued another 275' to an access road ditch. The litter and sediment volume was sufficient to fill a portion of the ditch and overflow the road. The water was split between going across and down the road and going down the ditch where it eventually crossed the road into a main drainage channel.

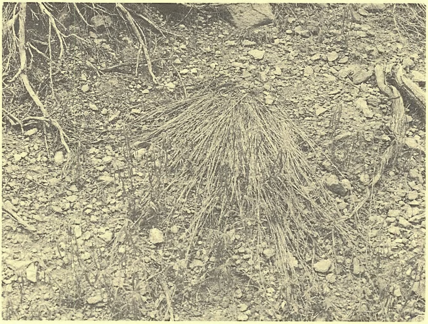
D. Hydrologic Soil Group B

The soils and ground cover were subjected to the same intensity storms as shown in the treated and untreated areas described in A, B and C. The slopes exceeded 55% (Fig. 14) and ground cover was approximately the same as the chained areas.

Figure 14.

Active erosion on these steep slopes consisted of slight gravity and wind erosion (Fig. 15). Litter was accumulating in place.

Figure 15.



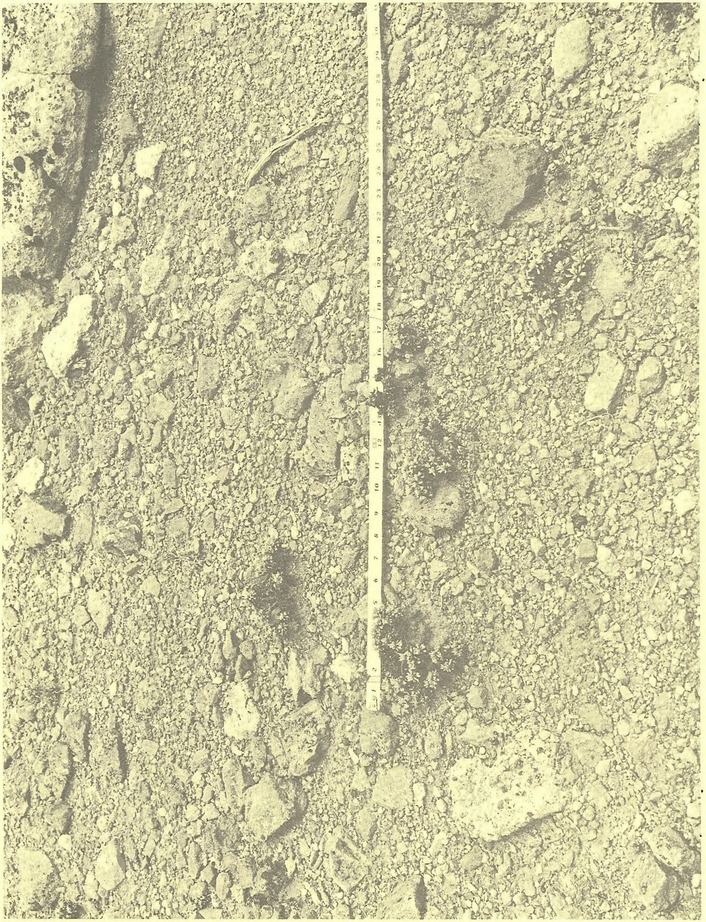
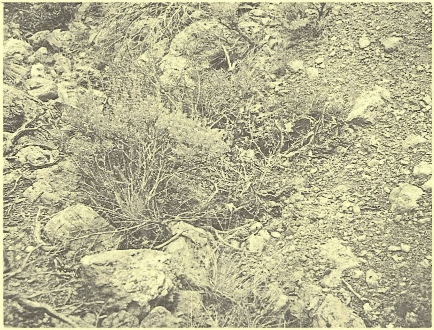


Figure 16.

Figure 17.

The drainage channels showed no signs of any overland flow for many years (Fig. 18), estimated at 10 years. Old litter, decaying oak leaves and mature plants indicated the channel had been stable for a considerable length of time.

Figure 18.



Comments

Considerable sheet erosion has occurred in the past on areas A and B. If overland flow is not significantly controlled, sheet erosion will continue to remove newly developed soil. These particles will either be deposited nearby as the result of small obstructions such as vegetation, litter, or rock particles, or flushed onto downstream locations. If the newly developed soil is kept in place, vegetation will have a chance to become established and develop into an effective check dam and soil retention device. Various plant vigor conditions can be easily identified in Figures 2, 3, 4, 5, 6, 7 and 9.

The effects of sheet flow and rainfall splash erosion can be seen in Figure 17 and 18 respectively. As sheet erosion occurs around the base of the plants, the plants become weaker due to an induced droughty condition. As the plant weakens and portions of it die, the soil becomes exposed and subject to splash and sheet erosion which in turn accelerates the erosion processes.

Plant List

Sandberg bluegrass	Poa secunda
Thurber needlegrass	Stipa thurberiana
Squirreltail	Sitanion hystrix
Blue grama	Bouteloua gracilis
Desert wheatgrass	Agropyron desertorum
Mutton grass	Poa fendleriana
Tailcup lupine	Lupinus coudatus
Aster	Aster scopulorum
Eriogonum	Eriogonum andinum
Cliffrose	Corvania stansburiana
Utah juniper	Juniperus osteosperma
Big sagebrush	Artemisia tridentata
Douglas rabbitbrush	Chrysothamnus vicidiflorus
Singleleaf pinyon	Pinus monophylla